

THE GOLDEN RULES OF EXTRICATION

Through the years, certain rules have come to the forefront that increase scene safety and provide for a more efficient extrication operation. The Golden rules are applicable in every operation and should be followed without question. These rules provide a solid base of operation for those firefighters who are less experienced with extrication and, if followed, will minimize the possibility of injury to the crews performing these operations. It is assumed that all vehicles will have, at a minimum, primary stabilization in place, even though the situation may not require any extrication. These rules are for the actual hands on extrication evolutions, but are also applicable to primary or secondary stabilization situations.

RULE # 1 - Never place any part of your body between the tool and the vehicle

The hydraulic tools that we are using operate at tens of thousands to hundreds of thousands of pounds per square inch of pressure. These tools have the tendency to shift or rotate one way or the other once they have gotten their bite on the vehicle. If this happens, and the tool operator is not aware of the potential danger, the tool will shift and can trap one or more of the operator's body parts between the tool and the vehicle. Due to the extreme forces being exerted by the tool, it can be very difficult to free the operator. If lucky, simply operating the tool in the opposite direction will free the trapped body part. However, in some circumstances, a lot more force may be required. Often times, operating the control handle is not possible because the handle or lever has been pushed into some part of the vehicle body in a manner that will not allow it to operate. The only way to free the rescuer then would be to pry the tool from the vehicle, which may require significant force.

Any part of the body can be susceptible, but the most common body parts to become trapped are the hands and the legs. This is because the tool operator's attention is usually fixed on the working end of the tool and not on the entire process or is not communicating properly with his or her partner (meaning that the operator is not listening to his or her partner's guidance). If this occurs, the potential for injury, to both firefighter and patient, increases tremendously. The pictures below illustrate improper technique followed by the simple solution



In this picture, the firefighter was making a relief cut to the bottom of the B-post when the tool started to shift into the vehicle. Leaving the hand between the tool and the vehicle increases the possibility of the hand being trapped and injured.

In the picture below, the entrapment danger is no longer present because of a simple re-positioning of the hand.



This picture is demonstrating poor technique in that the operator's body is between the spreader and the vehicle. If the spreader rotates towards the vehicle, it can push the firefighter into the patient compartment or trap the firefighter against the vehicle. The danger would be even more severe if the firefighter was attacking the door at the bottom hinge. If the spreader rotates towards the vehicle, the entrapment danger would then involve the rescuers legs.



Above, the entrapment danger is no longer present because the firefighter repositions his/her body away from the vehicle.

Rule # 2 – Never lean any part of your body into the tool

As mentioned in the first rule, the hydraulic tools we use operate at extremely high pressures. Most cutters use anywhere from 50,000 to 300,000 psi of force, some times more, to cut through the exotic metals and reinforcing posts in vehicles. Spreaders use anywhere from 30,000 to 70,000 pounds or more of pressure per square inch when spreading. Often times, the spreaders can lose their bite on the vehicle, and when this happens, the tool can recoil with tremendous force. When a vehicle is involved in a crash, the forces exerted on the vehicle are also extreme. The cutter can recoil once it has finally cut through metal, usually with less force than that of the spreader. However, if an operator is leaning against the tool with any part of his or her body, the tool can recoil into that body part. The resulting forces can easily damage soft tissue and break bones. The best method to protect the tool operator is to get a good bite on the vehicle with what ever tool is being used, then move out of the recoil zone and at safe angle from the tool. The previous picture shows the fire fighter doing this.

Rule # 3 – Let the tool do the work

Our hydraulic extrication equipment is very powerful tools. With that being said, the strength of a fire fighter contributes very little to the effectiveness of extrication operations. The tools are doing the work for us. There should be no need for us to manhandle the tools once they have gotten a bite, nor should we use our hydraulic tools as battering rams as a means to accomplish our mission. As firefighters, we need to understand that we are the brains of the tool and that our muscles, no matter how big and strong, should only be used for us to place tools in the correct spot.

Also, remember that the patient we are trying to rescue has just been through a violent vehicle accident. The last thing that they need to hear is someone banging and slamming tools into the vehicle. The normal sounds of extrication are amplified much more in the interior of the vehicle. Shaking the vehicle and hammering it can cause undue stress to the patient, making them to react in an adverse manner. Remember too, the position of some vehicle airbags and sensors. One well placed hit into the door of the vehicle can cause a live airbag to deploy into the patient.

This rule serves two purposes. The first is to protect the firefighters from back, shoulder and other injuries that could occur due to pushing, pulling and slamming of the tools. Back injuries are the most common injury in the fire service and any methods that can minimize these injuries must be utilized. The second is to conserve the firefighter's energy for the rest of the emergency and the rest of the shift. This is vital during the heat of the summer months, or if we must perform multiple extrications at one incident. Extrication operations can be very tiring, especially if the fire fighters operating the tool are constantly fighting or trying to manhandle the tool. The less experienced fire fighter is usually the first to become exhausted, however, more experienced fire fighters can succumb to the emotional aspect and stresses of a call and also over exert themselves.

The only effort that the fire fighter needs to exert is the initial effort of getting the tool into position and on its initial bite. Once the tool has its bite, whether using the spreader, cutter or ram, the operator should be able to step back out of the recoil zone and operate it with one hand. We, as rescuers, are here to place our tools in the correct spot, operate them efficiently and adjust the operation as necessary. The tool is there to do the dirty work. **WE THINK FOR THE TOOLS, THE TOOLS DO THE WORK!!!**



The picture on the left shows the initial effort of placing the tool in the correct spot. The picture on the right shows the operator achieving a good bite and working the tool with one hand.



In both of the pictures above, the fire fighters have achieved a strong, solid bite with the tools, are expending less energy and are now able to operate the tool with one hand. Doing this also allows emergency personnel to distance themselves from the recoil zone of the tool.

Rule # 4 –Listen to your back-up partner

It is very easy for any body to get sucked in by “Candle Moth Syndrome” where we focus all of our attention on the task at hand and forget about the bigger picture. When we are working a tool it is also very easy to come up with a plan, *not* see ineffectiveness of that plan and continue on without being able to adapt. This is one of the reasons why we have a partner backing us up.

It is amazing how much more of the incident can be seen by simply moving a foot or two back from the actual work. The backup partner should be able to see the bigger picture and notify the tool operator of any dangers of the current operation or if the plan is ineffective. For this reason, it may be more effective to have the more experienced fire fighter as the back up and have the less experienced fire fighter working the tool. With experience, firefighters should be able to remain calm during an intense situation, thereby allowing the less experienced rescuer to draw on that calmness. The fire fighter with more experience should also be able to adapt to adversity in plans much easier and then utilize any backup plans that they have in their mental tool box.

Rule # 5- Take what the vehicle gives you.

This most basic part of this rule deals with first part of any extrication - Try before you pry. Too many times we concentrate all our forces and energy one side of the vehicle when all we need to do is open the door on the undamaged side. The vehicle is giving us an option that is far less labor intensive, so why isn't our first option to try to open the door on the undamaged side. Just because we have extrication tools doesn't mean that they present the only method of removing a patient.

On a different scene, you may have one rescuer who prefers to remove a door from the hinge side and tends to use that method exclusively. However, the next vehicle that he or she approaches may only allow access from the Nader pin side. On another incident, because of the damage to the vehicle or its construction, a dash lift may be ineffective, requiring crews to employ the dash roll evolution. This means that when it comes to extrication, we must be proficient in as many techniques as possible. We may not be able to use our preferred method of extrication on every vehicle, but having more options available to us only increases our chances of extricating patients in a timely and safe manner.

We must also look for and exploit the weaknesses that our vehicle gives us. Stay away from the reinforced areas of the vehicle; attack them only if absolutely necessary. On the simpler side, instead of placing the tool in a certain spot that may not be the most effective, the vehicle may give us an opening, that by simply moving the tool a few inches or changing the angle of attack, allows us to accomplish our task much easier and safer. Choose the simplest method first and then, if needed, progress to the more difficult evolutions.

Rule # 6 – Always have back up plans ready for implementation

Firefighters are not the only personnel susceptible to the Candle Moth Syndrome. Sector, company and command officers may also fall into the trap when dealing with tactics and strategies. So it becomes extremely important for company and sector officers to develop back up plans in case the initial plan does not work. It is better to have these plans ready for implementation versus finding out late in the game that your plans aren't working.

Knowing that firefighters don't like to lose at anything, we tend to try the same technique or plan of attack far longer than necessary. This will not only affect the patients overall outcome, but it can also endanger everybody involved in the incident. We've all heard it or have even said it ourselves sometime in our career, "Gimme five more minutes" or "I've almost got it, I'm gonna get it this time". Again, nobody is immune; it can happen to the best of us. However, the person who already has a plan B and C ready for implementation tends to have the ability to see the ineffectiveness of a plan sooner. This person will also find it easier to abandon the current attack and move on to a different, perhaps more effective, plan of action. This is part of the constant evaluation of the situation that all personnel, especially supervisors, should be doing on the scene of any emergency.

The Golden Rules of Extrication were created in an attempt to keep fire fighters from injuring themselves and their patients, and to increase the effectiveness of extrication operations. In review, these rules are:

Rule # 1 – Never put any part of your body between the tool and the vehicle

Rule # 2 – Never lean any part of your body into the tool

Rule # 3 – Let the tool do the work

Rule # 4 – Listen to your back up partner

Rule # 5 – Take what the vehicle gives you

Rule # 6 – Always have backup plans ready for implementation

Emergency crews must constantly monitor each other to ensure that everybody involved in extrication ops is adhering to them. Using these rules will increase our efficiency, make operations safer for us and our patients and help us finish our twenty plus years healthy and with all limbs intact.

Helpful Tips and Techniques

As in any type of operation, there have been many tricks of the trade that have been passed down through the generations of firefighters. Some of these are more helpful and realistic than others. The techniques and tips discussed in this section have been developed through years of experience by experts in the field of extrication. If used correctly and often, these techniques should decrease the chances of injury and can save on the wear and tear that extrication operations can have on emergency personnel. In the end, our goal is to work smarter, not harder.

Use your legs, not your back

We operate using extremely heavy tools and often in cramped quarters. These situations can put a tremendous strain on the lower back and core area of our body. Lifting with our legs and having a strong core reduces this strain and allows us to operate in the awkward positions that we commonly find ourselves in. With back injuries being the most common type of injury that occurs to firefighters, this is a very important tip and every attempt to follow will decrease the injury potential.



Above, you see the firefighter is bending over at the waist, causing unneeded stress to the lower back



By using his legs to lift the cutters, the potential for back injury decreases significantly.

Support the weight of the tool with something other than your back

Decreasing the amount of time you actually support the weight of the spreader, cutter or ram prolongs the amount of hands on time you have with the tool. Creating a simple leverage system with your arms and legs can also assist the fire fighter in supporting the weight of the equipment.

One of the easiest ways of conserving energy is to use the vehicle as a table while opening or closing your tool in preparation for your evolution. Lay the tool on the hood or roof of the car, place the tips of the spreaders or cutters on the bottom of the window opening or on the rocker panel then open or close the tool. By using these surfaces to support the weight of the tool, less stress is placed on the firefighter.

Another method to support the weight of the tool is to create a leverage system with your limbs. This is especially useful when working on low points of the vehicle. There is a tendency to bend at the waist while placing the tool in a low spot. Obviously, this puts a lot of pressure on the lower back. Instead, bend at the knees and place your elbows on the top of your thighs to support the weight. The picture below demonstrates this technique.



Here, the fire fighter is crouched down, but by placing his elbow on his knee to use it as a fulcrum point, the tool's weight is supported much easier. This technique also creates a counter balance with the weight of the tool and the body of the fire fighter, making it easier to hold and maneuver the tool. Once the tool has achieved it's bite, the operator can now operate the tool with one hand.



Above, by dropping to one knee, the fire fighter is using another method to decrease the wear and tear to his back.

Use small bites

There may be times where we have difficulty controlling our emotions and adrenaline when it comes to extrication, especially when we have a critical patient trapped in the vehicle. This can sometimes cause us to operate our tools incorrectly. If the tools aren't worked correctly, the spreader can shred and tear the body of the car, making it more difficult to remove a door. The ram can lose its hold on the vehicle and shoot out violently if not operated slowly and carefully. This means we must have the patience to operate the tools in small increments. This is especially true when using the spreaders and rams. The tools should be operated with small movements until the tool gets deep enough in the vehicle to gain a good foot hold. Once the spreaders or rams have a good, strong bite, we can begin to work the tool with bigger movements. When operating our extrication equipment, remember that if we don't take our time and if we try to do too much, too fast, it can become counter-productive and delay the process. Be patient, stay calm and use small bites.

Attack at angles

Today's cars are a lot stronger than those made in the past years. Auto makers are manufacturing their vehicles with more reinforcement in key places in an attempt to increase passenger safety. Reinforcing bars are being placed in car doors with more frequency to protect passengers from side impact. Exotic metals are being used in posts, creating stronger roll cages to protect passengers during a roll over. Crumple zones are placed throughout the vehicle in an effort to absorb the energy of an impact and increase the time it takes for the vehicle to come to a stop after a crash. All of these safety features increase the survivability of the patient, but these same features can make extrication operations more difficult for rescuers.

Using angles to attack the vehicle causes us to work against the weakness of the vehicle instead of its strength. When attempting a door removal, instead of placing the spreader at a 90 degree angle to the vehicle, shift the tool so that it is now at 30 to 45 degrees to the car. These angles allow us to accomplish our task much easier. If we place the spreader at 90 degrees to the vehicle, the spreader tends to push the door into the either the A or B post, depending on which side of the door you are attacking from. On newer vehicles with reinforcing bars in the doors, this type of attack is working directly against the strength of the door, making the door removal extremely difficult at best. This operation can become even more difficult in a head-on collision because these same reinforcing bars can dislodge from their mounts and become lodged into the front and/or rear posts of the door opening. Once this occurs, the door is essentially locked in place by the reinforcing bar, making the door removal more difficult. Also, by attacking the door at a 90 degree angle, the middle of the door has the tendency to buckle into the patient compartment. This can compromise the patient in the event that he or she is pinned by the door. This situation commonly occurs in a T-bone type of crash. When we shift our angle, instead of working against the reinforcement of the door, we are now working against the weakest part of the door, the Nader bolt or the hinges. Now we are pulling the door away from the car *and* the patient.

Below, the picture demonstrates the door being attacked at one of it's weak points, the hinges. Notice how the door is being pulled away from the vehicle and away from where the patient may be sitting.



Shifting our angles doesn't only mean doing so on a horizontal plane; it also means shifting to the vertical. If we have had numerous attempts at opening a door from the Nadir bolt or hinge area without success, coming down vertically or near vertical, close to the window frame of the door, may be used as an option. Again, we will be working at the weaker portion of the door and this may give us just enough of a bite to pry the door open. This is an especially useful technique to use when previous attempts have torn the sheet metal in the area around the hinges or Nadir pin.

These are only a few tips that have been developed to assist in extrication operations. As more experienced is gained in this area, more tips and tricks of the trade will come to emergency crews. Using every trick or tip that is available to us will only make our operations more efficient.

VEHICLE STABILIZATION

When reading these instructions, it is important to remember that these evolutions are to be undertaken after the vehicle has been properly stabilized along with the initiation of patient care, if the situation allows. Primary and secondary stabilization will be covered in this section of the chapter. Also, in this section we will cover exposing the posts, different methods of creating purchase points for extrication ops, and step by step instructions on the different extrication evolutions. Again, it's important to understand that these are the more common extrication techniques being used by rescuers today. There will always be new methods developed to deal with constant innovations being made by the auto industry. The only way for rescuers to stay ahead of these advances is through constant training and education.

In any extrication operation, there will always be some form of vehicle stabilization required. Vehicle stabilization is an extremely important function that can be separated into two levels: primary and secondary stabilization. Every vehicle, regardless of the severity of damage, will require some form of primary stabilization, not every vehicle will require secondary stabilization. Regardless of which level the scene necessitates, it is extremely important that it is done correctly. We should not forget the importance of this part of extrication ops and train on stabilization just as diligently.

Primary Stabilization

Primary stabilization should be considered the basic level of stabilization that can usually be accomplished with a few pieces of cribbing, some wedges and a few hand tools. There are a few functions that are required for primary stabilization to be complete. They do not need to be completed in any particular order, however, all attempts should be made to ensure that at the very minimum, primary stabilization is completed prior to beginning any extrication operations.

The following functions of primary stabilization are as follows:

1. Immobilize the vehicle
2. Disable the vehicle
3. Expose the posts and cut seat belts

Immobilizing the vehicle

Immobilizing the vehicle can be a simple procedure or it could require more technical expertise. The majority of vehicle extrications involve vehicles that are sitting on all four tires. These situations require a few simple tasks in order to successfully immobilize the vehicle. If the vehicle does not end up on all four wheels, the simple functions described here will be the first steps required for secondary stabilization.

When a vehicle rests on it's wheels, performing the following functions will ensure that the vehicle is secure and immobilized. These functions can be summed up by remembering the following: Chock it, Block it, and Blow it.

Chock it

Chocking is a very simple procedure that should take care of the majority of the vehicle motion. Several different pieces of equipment can be used as chocks from simple wedge cribbing to a piece of 4 X 4 cribbing to step cribbing to the fire truck's wheel chocks. Simply chocking any tire or chocking multiple tires can immobilize the vehicle. However, if only one tire will be chocked, crews must

chock the front and rear of the tire; this will ensure that the vehicle will not roll in either direction. Crews also need to take into consideration which evolution will be performed when deciding which tire or tires to chock. For example, a front tire that is chocked in front and rear may not leave any room for cribbing to be placed under the car's A post. This placement can interfere with crews trying to perform a Dash lift. To avoid this, crews may chose to place wedges or chocks in front of the front tire and behind the rear tire. This leaves the area of the vehicle in between the front and rear tires free for cribbing placement and the necessary evolutions.

Block it

After chocking the vehicle, the next step is blocking or cribbing the vehicle. This entails placing cribbing underneath the car at four points, usually behind the front tires and in front of the rear tires. These spots are ideal because they provide a stable base for all extrication operations, regardless of which evolution will be performed. Again, the type of equipment used for this part of stabilization is the crew's preference. Typically, 4 X 4 cribbing, wedges or step cribbing will do the trick.

On the driver's side of this vehicle only one piece of cribbing was needed. Obviously more would be needed if the tires were on the vehicle.



On the passenger's side, a couple of pieces of cribbing along with a wedge were used. Each side may require different amounts of cribbing and wedges, depending on the vehicle's position.



Seeing how there are few evolutions toward the rear of the vehicle, step cribbing works well either in front of or behind the rear tires. However, the placement of step cribbing in front of the rear tire may interfere with the third door evolution. If crews are going to create a third door, placing the cribbing behind the rear tire may be the best option.

In this picture, a piece of step cribbing is placed behind the rear tire.



Different methods exist when blocking or cribbing up a vehicle. Crews may decide that a more stable base than the previously described method is needed. If this is the case, box cribbing may be called for. The box cribbing method simply means that the cribbing will be stacked in a box, with each level of cribbing placed in an alternating direction than the level underneath.

Below is a good example of a vehicle that is blocked using box cribbing



Rescue crews may decide that due to the weight of the vehicle or because of the ground conditions on scene, platform cribbing is a more suitable method of cribbing or blocking a vehicle. With this method, each level of cribbing is alternated as in box cribbing method; however, each level is placed on top of the previous level in a manner that creates a solid platform. There are no spaces between each piece of cribbing at each level. The advantage of this method is that, because there are more pieces of cribbing on each level creating a solid platform, more weight can be supported by the cribbing. The disadvantage is that platform cribbing uses a lot of cribbing. If the vehicle is lifted or is situated in a manner that the cribbing must be stacked high, truck companies will quickly find out that there is usually not enough cribbing carried on the truck. Again, the on scene companies must decide which method will best suit their needs on that particular incident.

There are a few general precautions to take when cribbing a vehicle:

1. Crews should never place any piece of cribbing underneath the vehicle using their hands. This follows Golden Rule number 1: Never place any part of your body between your equipment and the vehicle! Cribbing is a piece of equipment, if the vehicle shifts or rolls while you are getting ready to place the cribbing under vehicle, your hand or hands could get caught between the two. Using another piece of cribbing or a tool such as an axe or Haligan, keeps the crew members hands and fingers out of the danger zone. The following picture shows the firefighter using two pieces of cribbing to slide cribbing into place:



2. Cribbing becomes more unstable the higher you stack it, regardless of which technique you choose to use. A good rule of thumb to use when cribbing up to an object is to never stack your cribbing more than twice the length of the cribbing you are using. For example, in the following picture, crews are using cribbing that is 24 inches long to stabilize this trailer that was being pulled by a semi.



Using the rule of thumb the cribbing should go no higher than 4 feet or 48 inches. You can see how both of the taller stacks of cribbing are leaning a little to the right. The stack on the left looks as if it is bowing out to the left, right in the middle of the stack. Because of the height of the cribbing, this trailer is not stable at all. If on scene crews determine that cribbing will need to be stacked this high, all efforts should be made to use longer cribbing. Carrying extra 10 foot pieces of 4 X 4 lumber on the trucks will give responders the ability to cut cribbing to a suitable length while on scene. Remember, the goal of cribbing or blocking a vehicle is to create a **stable** platform for crews to operate on.

Blow it

Once the vehicle has been blocked, it is time to blow the tires. When full of air, the tires are like bouncing balls that can rock the vehicle back and forth during operations. By removing the air from the tires, the car will rest on top of the cribbing that the crews just placed at four points under the vehicle to create a stable operating platform.

Deflating the tires doesn't require any technical expertise, but crews should accomplish it safely. The most common methods, however, are pulling the valve stem or puncturing the side wall. A set of pliers is a useful tool to pull valve stem, also some heavy duty wire cutters can cut the stem. For the side wall of the tire, any sharp tool such as the pick of a Haligan or axe, or a sharp knife can easily puncture through the tire. Now, instead of the vehicle resting on four bouncing balls, it is resting on the cribbing, creating a stable operating platform.

Primary stabilization on side and roof resting vehicles

Not all vehicles land on their wheels after an accident, however. Some lie on the side, roof, on top of another car or wall. Regardless of the position in which the vehicle lies, chocking is still applicable, just maybe not at the wheels. There is still a requirement for initial immobilization that can be considered part of primary stabilization. A vehicle on it's side, for example, is still very unsteady but usually doesn't roll back over onto their wheels or onto their roofs. Usually, it takes a significant force applied to the vehicle to roll it back on to its wheels or the roof. There is also a chance of the vehicle rolling if the roof and posts have been crushed to the point where they don't provide any support. But even if none of the aforementioned scenarios were to happen, vehicles can still be very unstable to the point of being dangerous for any patient inside.

Simply placing wedges at key points is very effective for immobilizing a vehicle on its side or roof. For a car on its side, first place wedges under at least two of the roof posts. Any of the posts will usually suffice as long as they do not interfere with operations. These wedges do not need to be driven very hard into the vehicle. A couple of taps with a sledge hammer will work to create just enough resistance between the wedge and the vehicle.



In the picture above, crews are using a combination of 4 X 4 cribbing and wedges set in place with a sledge hammer.

In this scene, crews used step cribbing under the B post on the roof side for stabilization. Another option would be to turn the step cribbing upside down so that it is used as a large wedge.



Because the tires help to keep the vehicle from rolling back onto its wheels, placing the wedges on the roof side of the car is a good start. Crews can then move to the undercarriage side of the vehicle to place wedges to firm up the vehicle and prevent it from rocking. Again, the wedges need to be placed in an area that will not interfere with extrication operations.



Tapping the cribbing and wedges in place on the undercarriage side now puts pressure onto the wedges and cribbing on the roof side, further stabilizing the vehicle.

For the majority of operations, this level of stabilization may be all that is required, especially with older vehicles. The bodies of older vehicles are shaped more like bricks and are usually pretty stable when they land on their sides. Newer vehicles, however, are built with round bodies that rebound and are less stable when on their sides. Regardless of the body type, if crews feel that this level of stabilization is not sufficient, they can progress onto the more technical level of secondary stabilization, which will be discussed later.

For vehicles on their roofs, the initial immobilization requirement may also be accomplished through the use of wedges. Usually, because of the extra weight, the engine side of the vehicle will be the low side of the car. This is almost always the case, regardless of type of the engine or whether it is in the front or rear of the vehicle. The issue of stability in this type of scenario is not much of an issue. The major reason to immobilize a vehicle on its roof is to keep it from sliding, especially if the vehicle is on a slope. The wedges and/or cribbing can be placed in any part of the vehicle that will keep it from sliding. There are no set rules or locations for wedge placement, as long as you keep the vehicle from sliding. The most common place to wedge is at the posts and under the roof. This can be especially important if crews elect to flap the roof down or completely remove the roof as the weight of the vehicle now rests more towards the engine side versus the roof posts. Once the roof support posts are cut or removed and the vehicle is supported by struts or cribbing, the vehicle may slide forward. The arrows below show some common places for wedge placement.

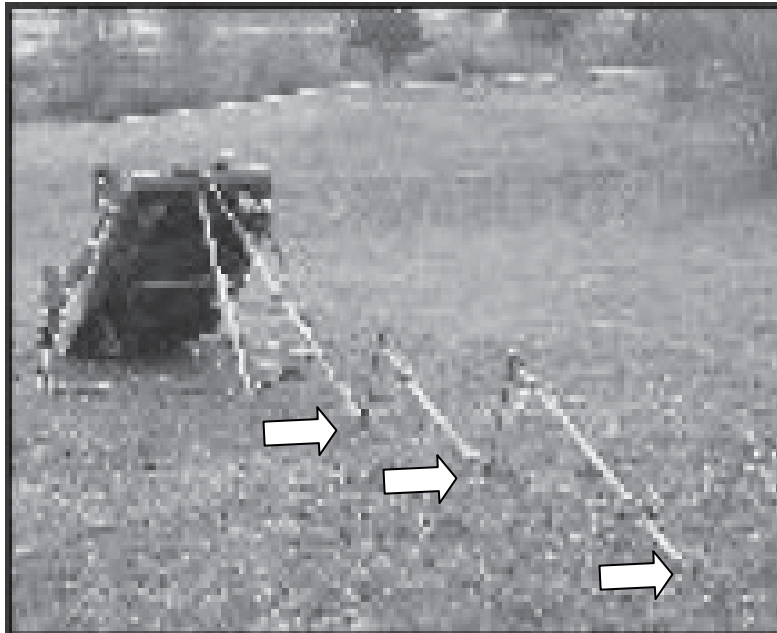


Another option to immobilize a roof resting car is to hammer one or two pickets through the low side of the vehicle and into the ground (usually the engine side). This will effectively keep the vehicle from sliding.

This picture shows the picket that was driven into the vehicle:



If the vehicle is lying on a downhill slope, crews can use pickets in a daisy chain set up for immobilization purposes. The number of pickets used in the chain is dictated by the amount of support needed to keep the vehicle from sliding down the slope. Again, follow the manufacturer's instructions for setting up the daisy chain to the vehicle.



Disabling the vehicle

Now that we have immobilized the vehicle, we can concern ourselves with disabling it. The objective we are looking for when disabling the vehicle is to secure the vehicle's power so that all the electrical systems are completely shut down.

A simple five step process can be applied to every vehicle, regardless of the type, that will completely secure the system:

1. Turn off the ignition
2. Turn on the emergency flasher
3. Unplug any accessories
4. Disconnect the battery
5. Verify system shutdown

Turn off the ignition

Turning off the ignition will secure 90% of the systems on any vehicle. In gas, diesel, propane and natural gas vehicles, fuel pumps will be shut down leaving only residual fuel in fuel lines. Relays in hybrids and electric vehicles will open, which ceases the flow of the electrical current through the high voltage lines. Any fuel delivery system of any vehicle will stop feeding fuel once the ignition is turned off, causing all engines to shut down.

For some vehicles this is accomplished by simply turning the key to the off position and removing it from the ignition. When this is possible, it may be a good idea to place the key on the dash board so that it can provide visual confirmation that the vehicle's engine is off. Also, some vehicles are

equipped with key fobs that can start the vehicle remotely. Removing the keys from the ignition will also disable this system.

Quite a few auto makers are now using smart keys that allow the car owners to unlock vehicle doors, set certain seat settings and even start the vehicle without having to actually use the key. The door and seat setting functions can be done as soon as a proximity sensor in the car receives a radio pulse from a generator inside the key housing. The distance required for this to occur is usually around 5 feet from the vehicle. The big misconception regarding these systems is that the vehicle's engine will automatically start once the key comes within the 5 foot range. The reality is that this proximity function only unlocks the doors and trunk in some vehicles and in others, it also sets the mirrors, seats and steering wheel to preprogrammed settings for the specific person assigned to that key. In order for the engine to start, the key must be inside the vehicle with the driver, the transmission must be in "Park", the brake pedal must be pressed and an ignition switch or button must be turned or pushed. If any one of these requirements is not met, the vehicle will not start. Once the car's ignition button or switch is pushed or turned, these vehicles are essentially the same as any other vehicle.

Turn on the emergency flashers

As soon as crews have the opportunity, the emergency flashers should be activated. The emergency flashers will give a visual warning to all personnel operating in and around the hot zone that the vehicle's power has not been secured. If the emergency flashers can not be activated, all efforts should be made to notify emergency personnel that the power has not yet been secured.

Unplug any accessories

In the early 80's, auto makers began equipping their vehicles with on board computers to manage the various systems on their cars. In order to access any stored data on these computers when the vehicle's power was secured, mechanics used and still use a device that feeds power back into the vehicle's computer. This device is connected to the cigarette lighter port or power port of the car. The device simply consists of a male power plug connected to a small cable that is then connected to a 9 volt battery. The 9 volt battery provides sufficient energy to power the vehicle's computer.

This same technology, called "Power back feeding" can be hazardous for emergency personnel. Accessories that have rechargeable batteries, such as cell phones, portable DVD players and laptops, can feed power back into the vehicle's electrical system, even after the battery has been secured. If the vehicle's ECU is re-energized, so are all the pyrotechnic safety devices in the vehicle. Now rescuers are facing live and loaded airbags, seat belt pretensioners and deployable roll bars. Engineers performed controlled tests and found that a cell phone's fully charged battery sent enough energy through the vehicle to power the ECU and were also able to trace energy through the entire car, all the way to the cut battery cables. To avoid any possibility of back feeding power into the vehicle's electrical system, crews must unplug any and all accessories as soon as possible.

Disconnect the battery

Disconnecting the battery is by far the most effective method for securing the vehicle. After the battery is secured, capacitors will begin to discharge any stored energy, high voltage systems in hybrids will shut down and all electrical systems will be secured.

Just as in airbags, batteries in today's vehicles can be mounted in different locations. Batteries can be mounted in the traditional location under the hood, but some can be found in the trunk of the car or under the rear seat, in the passenger compartment. Rescuers may not be able to secure the battery on certain vehicles, due to the location, until after the patient has been removed. If this is the case,

precautions must be taken to avoid the deployment zones of the various airbags, roll bars and other safety systems.

Accessing the batteries that are under the hood can be accomplished a few different ways. Obviously, the simplest method is to activate the hood release from the inside of the vehicle if there is minor damage to the hood and front end. With more extensive damage, this option may not be possible. The first place crews tend to attack is at the hood latch assembly. Using a set of irons may take some effort, but with the use of hydraulic spreaders, the task can be accomplished with ease.

Here we see a fire fighter attacking the hood latch, creating an opening in the front of the hood for the spreaders.



Another way to gain access to the engine compartment is to attack the hood from the other side by cutting the hinges. All hoods have crumple zones in the middle to prevent the hood from flying into the windshield during a frontal collision. Emergency crews can use this weak point to create an opening for the hydraulic cutters. Crews can then cut the hinges and fold the hood forward.

The next pictures illustrate this method:



The cutter operator must be careful if there are gas struts used to support the hood. When cutting through a strut, the operator must make sure to cut through the strut shaft and not the housing. The housing contains high pressure gas that if cut, could become a high speed projectile and cause significant injury.

In this picture, a firefighter was attempting to open the hood of a vehicle that was on fire. The hood strut dislodged from its mounts, hit the street and ricocheted back up into his leg. The force and speed of the strut was significant enough to force the strut through the vehicle and the firefighter's turnouts.



Once access is gained to the battery compartment, crews can then secure the battery by either removing the cables from the battery posts with a wrench, or they can cut through the cables with wire cutters. When cutting the cables, crews should remove a section of the cable by making two cuts about 6 inches apart. This will ensure that the cable ends will not come into contact with each other during extrication operations.

Verify system shut down

Once the battery is secured we can move on the final step of disabling the vehicle: verifying that the system is actually shut down. This is simply accomplished by looking at the emergency flashers, that we activated earlier, to see if they are off. The lights on the dash board panels should also be off. If one of these is not the case, crews must search for a second battery and attempt to disconnect that one as well.

Expose the Posts and cut seat belts

The final step of primary stabilization is to expose the posts and cut seat the seat belts. Various posts contain components that should be avoided. Reinforcement for the mounting of the seatbelts can cause damage to cutter blades. Seatbelt pretension systems can also damage hydraulic cutters or much worse, injure somebody. The biggest hazard, however, is the airbag inflator. As discussed before, these cylinders are pressurized with gas at 3000 to 4000 psi. Serious injury can occur to both patient and rescuers if one of these cylinders is accidentally cut.

For these reasons, it is imperative that we always expose and investigate posts prior to beginning operations . Remembering the PIC acronym is always helpful:

P- Peel or Pull the molding

I – Investigate

C- Cut

Peel or Pull

This refers to the action of removing all the plastic molding from around all posts to expose as much of what is underneath as possible. Some useful tools in pulling the plastics are a small pry bar, a large flat head screw driver or a FUBAR, which is a tool that combines a pry bar at one end and a hammer and claw at the other end. None of these tools are considered specialty tools and can be found at any local hardware store.

The following pictures demonstrate this technique.

Peeling the plastic to expose as much of the posts and roof as possible.



A good majority of B-posts contain seat belt pre-tensioning devices along with their high pressure cylinders.



Investigate everything we just exposed

Crews should then perform a quick scan of all exposed posts as well as try to identify the possible locations of any air bags. Some vehicles will not have air bag ID stamps, so rescuers must assume that airbags are present and stay out of the deployment zone.

Fire fighter performing a quick scan of the interior of the vehicles posts:



Cut

Now that the posts have been exposed and a quick interior scan has been performed, we can make our cuts.

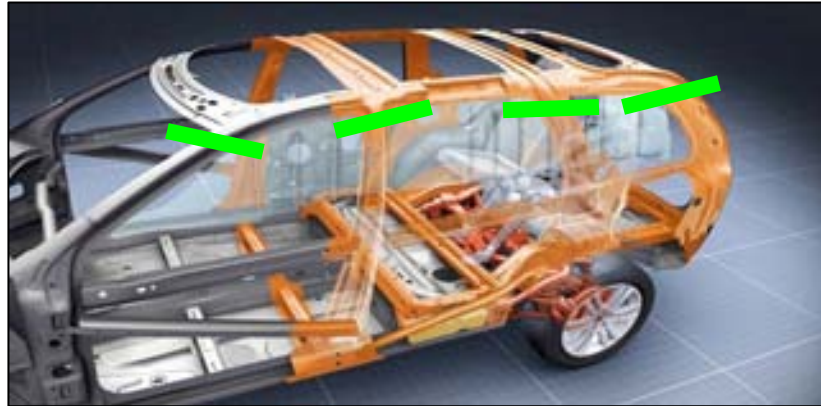


As stated before, there are no industry standards on the locations that these cylinders can be mounted. As rescuers, we should be aware that these cylinders can be located in any of the posts or along any part of the vehicle's supporting roof rail. We need to be prepared to protect ourselves as well as our patient during these operations.

Some SUVs, such as the Ford Excursion, Chevy Suburban and other such vehicles, have more than one head curtain airbag on each side of the vehicle. This obviously requires more than one pressurized cylinder per side. It is imperative that we expose all the posts by pulling as much of the plastics as possible prior to making any cuts and to operate out of the deployment zones of the airbags.

Remember, if peeling the plastic is not possible, using the rule of thumb of cutting high on the posts will give us the best chance of avoiding any gas cylinders, regardless of which post we are cutting.

This picture shows the safest places to cut. By cutting in these areas, crews are also attacking the narrowest part of the post.



Cut seat belts

Seat belt pretensioners may not always deploy during an accident. An un-deployed pretensioner could possibly fire during operations, causing further injury to the patient. This hazard is removed when crews cut the seat belt. Also, taking a couple of extra seconds to cut the belts, prior to removing or flapping the roof, can prevent any further injury to the patient as the roof is lifted off the vehicle.

The steps of primary stabilization are now complete. To summarize, primary stabilization consists of the following functions:

1. **Vehicle immobilization** – accomplished by chocking, blocking and blowing the vehicle; chocking the tires, blocking or cribbing the vehicle at four points and blowing or deflating the tires.
2. **Disable the vehicle** – accomplished by using the following five steps
 - a. Turn off the ignition – to disable up to 90% of all systems in any vehicle
 - b. Turn on the emergency flasher – to provide a visual warning to other personnel that the vehicle still has power.
 - c. Unplug any accessories – to avoid “power back feed”
 - d. Disconnect the battery – to allow capacitors to drain their power and disable the airbags, pretensioners and deployable roll bars
 - e. Verify system shutdown – to ensure that vehicle no longer has power.
3. **Expose all posts and cut seat belts** – to confirm the location of pressurized cylinders and to prevent further injury to crews and patients

Primary stabilization is an extremely important function of any extrication operation. Rescuers must be as skilled and disciplined in this part of extrication as with any other evolution. For the majority of extrication incidents, emergency crews will not have to go further than primary stabilization. However, due to the nature of the incident, some of these steps may not be able to be completed until secondary stabilization is completed. On scene crews must attempt to complete as many, if not all, of these functions prior to beginning any operations. Once primary stabilization has been completed, crews can then decide if secondary stabilization is warranted.

Secondary Stabilization

Every now and then rescuers are confronted with a vehicle that requires more than primary stabilization. It could be that the vehicle on its side is still unstable after the initial stabilization efforts are completed. It could be that crews will need to provide more support for a vehicle on its roof in order to remove the roof. Or it could be that a truck company is confronted with a situation where the vehicle is resting in an awkward position and any extrication operations could cause it to shift or roll. Whatever the case may be, crews must be prepared to take their stabilization skills to the next level. What will assist crews in these situations is the experience, ingenuity and the countless hours of training gained throughout their collective years.

Secondary stabilization is more technical than primary stabilization. As technical as it can be, this level of stabilization requires some critical thinking and creativity. Not every situation or scenario can be preplanned or even imagined, there may be times when procedures need to be created on scene. To attempt to give stabilization instructions on every scenario would be impossible, so the information provided in this section will be offered more as guidelines and recommendations to consider, rather than rigid step by step processes. Remember, there are no specific techniques for secondary stabilization; if your methods created on scene are safe and effective, you have accomplished your mission.

Stabilization Struts

We will begin by looking at the operating principles of the most common tool used in secondary stabilization – the strut. We will cover some of the more simple situations that crews may encounter and provide some options for stabilization. We can then provide an in depth coverage of secondary stabilization and guidelines to follow on the more complex scenarios. We will not be able to cover every possible scenario, but hopefully, the guidelines provided in this section will help on scene crews develop a few good plans of action.

Struts are extremely effective at stabilizing vehicles that rest in awkward positions. The main purpose of a strut is to stabilize these awkward lying vehicles by widening their base. Our goal is to create more points of contact between the ground and the vehicle (using struts and cribbing) while extending the vehicle's footprint as wide as possible. We can use the simple geometry to help us accomplish this. If we take a triangle with a wide base or foot print, it will provide more stability and less movement, a triangle with a narrow base or foot print means less stability and the possibility of more movement.



Wide base = more stability

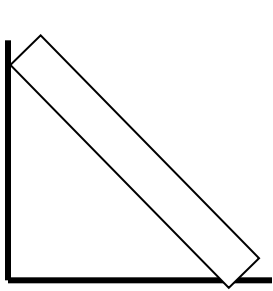


Narrow Base = less stability

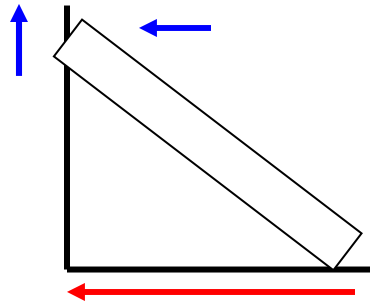
Tensioned Buttress

As we've already said, we are attempting to minimize the movement of a vehicle by widening the foot print or base. We accomplish this by using the struts, regardless if they are wood, steel or composite,

as tension buttresses against the vehicle. If we simply lay a strut against the vehicle, we would merely have a buttressed system. But, when we apply tension to the lower portion or base of the buttress (red arrow) and pull it toward the vehicle, a side and upward force (blue arrows) is applied to the vehicle's upper portion which now creates tension at those areas; now we have a tensioned buttress.

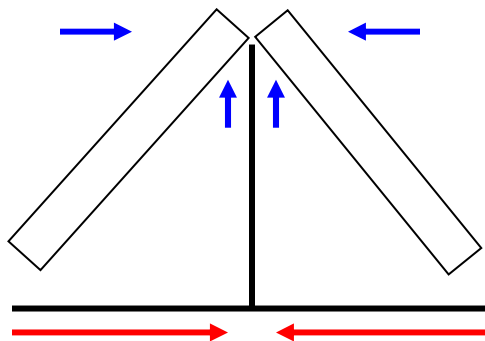


Buttressed system only



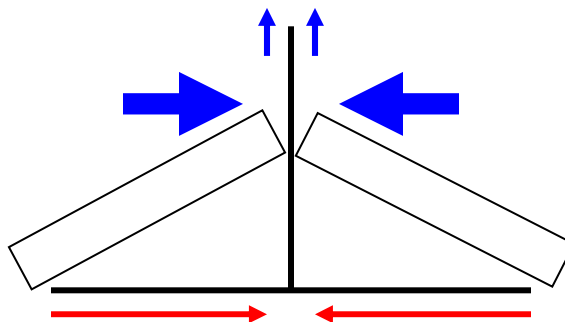
Tensioned buttress

Using this principle, we can create a stable situation by applying a tensioned buttress on both sides of the vehicle and pulling both bases toward each other.



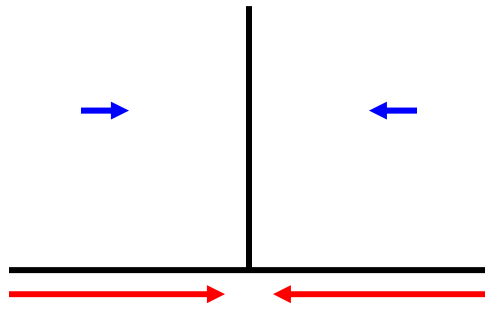
The opposing forces will create a stable, unmoving vehicle.

The width of the bases will determine how much directional force is applied by the buttress system. If the base is wider, more of the force is applied into the horizontal plane as tension is applied, as illustrated below.



If a narrower base is utilized, more of the force is applied to the vertical plane.





If we apply these principles to a vehicle, regardless of which position it is in, we can increase the stability of the vehicle and decrease the possibility of it moving.

Below, we see the struts being used as tension buttresses on both top and bottom of the vehicle

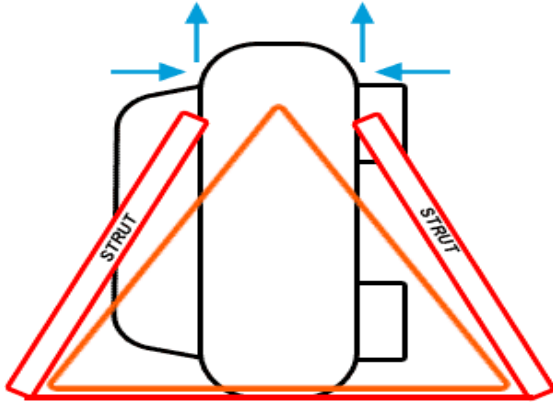


Here we see crews using 4 x 4's as their tensioned buttresses.

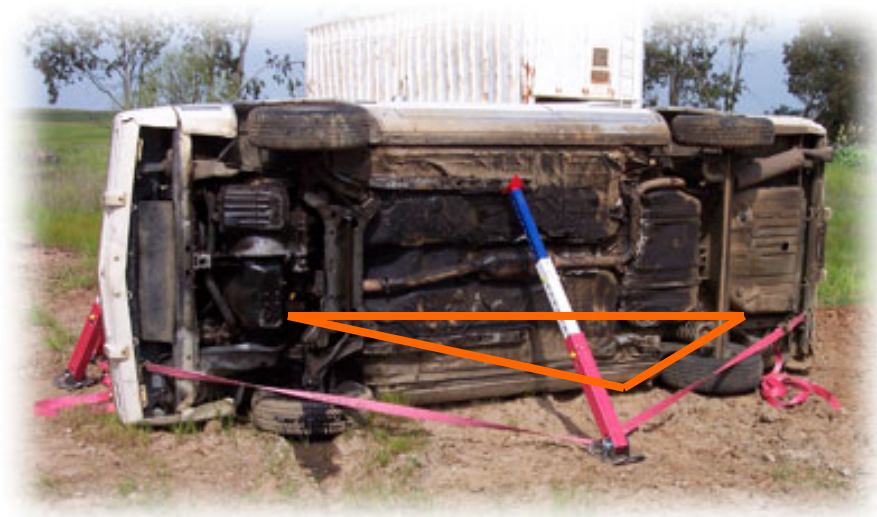


Triangles

When setting up our struts, we must also think in terms of triangles. We need to create triangles all around our struts to provide a strong system. On the left, we see a drawing of how the triangle, with its wide base, is created using the tensioned buttresses. On the right, we see its practical application.



We can also think in terms of triangles at the bases when attaching the ratchet straps. Creating triangles with the straps decreases the chances of the base moving laterally during operations. This type of system is more secure than pulling the opposing bases together with a single strap. This is because the strap pulls the base of the strut into the vehicle, keeping the base from slipping out, while pulling the base laterally in opposing directions to prevent the base from slipping laterally.



***Remember, the wider the triangle created by the straps, the more stable the base of the struts will be.

Struts are also manufactured with heads that are designed to grab a hold of different parts of the vehicle, from frame rails in the undercarriage to support posts at the top of the vehicle. Regardless of the brand of struts used, crews should follow the manufacturer's guidelines and train with them as much as possible so that they become proficient in all aspects of their use.

Below are some of the different heads used by different brands of struts:



As you can see, these heads are designed to set into and grab different parts of the vehicle. Each head has its advantage and disadvantage and crews must decide which will best fit their needs.

We can now apply the principles we've just learned to vehicles that lie in a number of different positions. As long as you remember that you need to create a tension buttressed system as well as creating wide based triangles with your struts and straps, your vehicle should be sturdy enough for even the most difficult operation.

Rules for using struts

There are a few rules and safety precautions that crews must adhere to. These may vary a little from manufacturer to manufacturer, but all in all they pertain to every situation.

1. Obviously, the Golden Rule #1 pertains here and in every operation: Never place any part of your body between the vehicle and your equipment. This has been covered many times in this chapter and should seem self explanatory by now.
2. The head of the strut should only be placed into the skin of the vehicle for stabilization purposes. If crews are going to use the struts to support the entire weight of the vehicle, or any portion of for that matter, the head should be placed into an area of the vehicle that is reinforced and can support the weight. Crews can also cradle the vehicle using chains to support the vehicle's weight. Again, follow the manufacturer's guidelines when creating a cradle. The skin of the vehicle can easily tear, especially after it has been involved in a crash. Personnel should not rely on this part of the vehicle to bear any significant amount of weight.

3. Always attempt to place the head of the struts as high as possible into the vehicle. If possible, the head should never go below the midpoint of the vehicle, no matter what position it is lying in, sometimes this may not be possible. Depending on the position of the vehicle, the lower the head is placed, the less stable the vehicle is. This becomes especially true side resting vehicles.
4. Never apply a side or lateral load to your struts. This means that crews should ensure that no part of the car should come in contact with the side of the strut once tension has been applied to the base. A strut is designed to maintain its strength when force is applied down the length of the strut. If a lateral force is applied to the strut when tension has been applied, the strut may fail.
5. Never exceed the maximum rated work load of the struts and their accessories. Each brand of strut has different rated capacities so crews must know their equipment inside and out to avoid equipment failure.

Again, these are generic rules that apply to all struts, regardless of brand or style. Crews should know the capabilities and limitations of their equipment prior to using them on scene. If crews are unfamiliar or untrained on their equipment, disaster can happen.

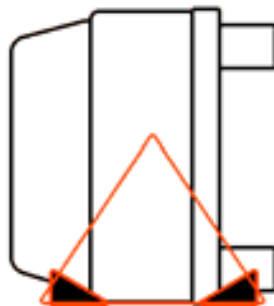
We will now cover some of the scenarios in which crews are likely to come up against. Hopefully, crews can use this information to help them in formulating a plan of action for a more complex stabilization situation. We will cover stabilization techniques for a vehicle on its side and roof and then move onto the more complex scenario.

Simple Secondary Stabilization Scenarios

Side Resting Vehicle

The simplest stabilization scenario is the vehicle on its side. Older model vehicles usually didn't require anything beyond primary stabilization. Their bodies were square and built like bricks. The sheet metal used for their bodies was also thick and provided a lot of support. The style of the body meant that more surface area of the vehicle was in contact with the ground, creating a wider foot print or base. These are the types of cars that we normally train on when we go to the junk yard. They are very strong and pose very little stability issues.

Older vehicle (brick)



Usually, the simple act of placing wedges on both sides gave the vehicle a wider base and was enough to keep it from moving.

Newer vehicles, on the other hand, will not be so stable. Their bodies are manufactured with less material, but that material is more dent resistant. The roundness of the body style of these vehicles means that there is less surface area in contact with the ground, meaning a narrower foot print or base.

These attributes make the vehicle less stable because the body doesn't provide any support. Placing a wedge into the body only causes the body to deform around the wedge and usually does very little to stabilize the vehicle. If older vehicles were more like bricks, it could be said that newer cars are more like balls.

Newer car (ball)



Now that we have discussed some of the differences of newer and older vehicles, we can begin our stabilization process. Once our primary stabilization efforts are complete, we begin looking at how we can use struts and/or cribbing for secondary stabilization. Crews can choose to stabilize a side resting vehicle by either using two, three or four struts. The minimum number of struts that should be used are two; obviously, the more struts used, the more stable the vehicle becomes.

When placing the struts, crews should first place them on the most unstable side of the vehicle, usually the roof side. One strut could be placed at the front of the vehicle and one toward the rear. Placement of the head of the strut should be in a location that will not interfere with extrication operations. Some common locations are along the A post, the support rail of the engine compartment, the sheet metal of the hood itself or any location that will provide support needed to perform extrications.

Here, a fire fighter is placing the head into the hood and the trunk of the vehicle.



Placement of the head of the strut into the car's sheet metal will provide the necessary support for stabilization only. This type of placement should not be used to support the weight of the vehicle, such as when crews plan to lift the vehicle off the ground or off of another vehicle. The sheet metal will not support the car's weight and will tear easily. For lifting operations, some other hard point that can support the weight of the vehicle should be used. The A post on the picture below left is used to support the vehicle. On the right, the strut head is placed on the window frame of the rear door.



Most strut manufacturers use some form of ratchet and strap to secure the base plates and pull them into the vehicle. With wood 4 x 4's, rope can be used. There are, however, plenty of options for setting the base plates and straps of the struts. The ratchet straps can be attached from base plate to base plate or from base plate to vehicle framing.

There are two options for base plate to base plate attachment. The picture on the left shows the basic and most often used base to base attachment. Crews attached the ratchet strap to one base, ran the strap under the side resting vehicle, then attached the other end of the strap to the other base. The bases were then pulled together to apply tension to both bases at the same time. The picture on the right shows a different base plate to base plate attachment. There are four struts placed around the vehicle, the straps are connected to the bases of each strut and never come in contact with the side resting vehicle. Each method is equally effective as long as the crews are well trained in the set up.



Base plate to vehicle attachment: one end the strap is attached to the lower A post or other hard point, the other end is wrapped around the front of the vehicle and attached to a hard point at that end. Notice the wide triangle created by the strap at the base.



Each method of attachment has its advantage and disadvantages. The advantage of base to base attachment is that crews use one strap for two struts. The disadvantage is if one of the base plates loses its footing and slides out, the other strut loses its tension and footing as well, causing the vehicle to become unstable again. The opposite is true for the base plate to vehicle attachment: each strut has its own attachment point and does not rely on a second base plate to create tension. The disadvantage is that this type of attachment requires more straps or ropes.

On the undercarriage of the vehicle, crews should place the struts in a location that will provide the required stabilization while ensuring that the struts are out of the area of operations. Again, the different head designs allow for multiple placement possibilities. There is one important precaution to adhere to, the parts of the vehicle that move, such as the suspension, drive train and tires should not be used as a location to place the head. If these locations are used, there is a risk that any movement will cause the head to slip, causing the vehicle to become unstable.

Here the struts are placed out of the operating zone with the base plate to vehicle attachment being used. On the right wood struts are used with a 4 x 4 piece of wood laid across the bottom for the base plate. A rope is then used to pull the struts into the vehicle, not really creating a tensioned buttress system but rather holding the wood struts in place.



The picture below shows crews using the three strut method. Notice how crews create a large triangle base with the straps, firmly holding the base of the strut in place. Also notice how this type of stabilization places the strut in an area that may interfere with operations on the underside of the vehicle. Crews must anticipate this possibility when choosing the method of stabilization.



Again, crews should attempt to create as wide a base as possible with the struts while still keeping the head of the struts at the highest point of the vehicle. This may require the struts to be extended to their full length.

Each method is very stable and sets up with very little time and effort. With enough training, it is possible for one fire fighter to completely stabilize a side resting vehicle in a little more than five minutes. With more than one crew member working at different areas of the car, stabilization can be easily accomplished in less time. Which ever method is going to be used, crews must follow the set up and operating instructions specific to their strut manufacturers.

Roof resting car

A vehicle resting on it's roof is also very easy to stabilize. Crews must remember to first prevent the vehicle from the possibility of sliding forward by placing wedges into the low side (usually the front of the car due to the engine weight), driving pickets through the engine compartment and into the ground or by using the pickets in a daisy chain if the vehicle is on a downhill slope.

Once the crews have completed primary stabilization, the struts can be put in place. There are many options for strut placement, as long as the end result of creating an immovable vehicle has been achieved.

In both of the scenes on the following page, crews opted to place large struts into the skin of the vehicle. On the right, crews chose to place smaller struts into the door frame for added support. Remember, the head of the strut can be placed into the skin of the vehicle for basic stabilization only.

If crews anticipate that the struts will be used to support the entire weight of the vehicle, as in a lifting evolution, the head must be placed into a reinforced area or a cradle with chains must be created to support the vehicle (this will be covered later).



The following pictures show crews using struts in conjunction with cribbing:



Here crews use cribbing only:



The scenarios we just covered can be classified as simple situations that require secondary stabilization. Most crews should be able to handle these situations with adequate training and equipment. As long as know the capabilities and limitations of their equipment these stabilization

situations will be easily handled. If crews are not familiar with their tools or try to exceed the tools capabilities, disaster can happen.

Complex Secondary Stabilization Scenarios

Every now and then crews are presented with a situation that can leave even the most seasoned fire fighter wondering how to proceed. What will get them through this is the collaborative effort of all crew members and the years of training. It is virtually impossible to cover every type of scenario that we might come up against, but we will attempt to provide the information necessary for rescuers to make the best decisions. Remember, as long as the vehicle is stable and doesn't move after all efforts are complete, crews have accomplished their mission of vehicle stabilization.

Vehicle on an object

After a wreck, a vehicle may come to rest on a number of different objects ranging from another vehicle, to a pole or tree, or a wall. Initially, this type of incident may seem to provide emergency personnel with major stabilization challenges. But after some simple primary stabilization steps have been completed, the rest of the stabilization process will follow along easily.

The first step in any situation like this would be to secure the vehicle on top of whatever it is sitting. The easiest way of doing this is to tie the vehicle off to object on the bottom. The bottom sitting object could be another vehicle, a wall, a tree, a pole or any other similar object. Crews can use the same ratchet strap that is used with struts, a rope can also be used or anything else that can secure both objects together. What this does is effectively turn two separate objects into one more solid piece, preventing the top sitting vehicle from sliding off the top or the bottom object from sliding out from under the vehicle.

The following pictures show vehicles being tied off. Crews can tie off the vehicle anywhere that is effective. Crews do need to anticipate where their operations might take place and place the straps in an area where they will pose no interference.

Vehicle tied off to another vehicle



The top sitting vehicle pictured below may provide crews with a little challenge. Multiple straps on the roof and undercarriage sides of the top vehicle can be used to secure it to the vehicle on bottom. Once they have been tied together, crews can then begin placing struts to stabilize the top sitting vehicle. Also, we can not forget about the vehicles on the bottom of the stack, they need to be

stabilized as well. Perhaps primary stabilization will be the only level at which the bottom vehicle will need.



The cars in the following pictures have not been secured yet. It is imperative, however that crews tie the vehicle off before they begin to stabilize with struts. The mere act of placing a strut into the car can cause it to slip from the position it is in.

In this picture, the tree would provide sufficient support to tie the vehicle off.



Here a strap going from the rear of the vehicle to the retention guard can be effective



Tying off the vehicle to whatever it is resting on can be considered a part of the immobilization portion of Primary Stabilization. Once this has been completed, crews can chock the tires (if any are

on the ground) further immobilizing the vehicle. After primary stabilization has been completed, crews can then move on to secondary stabilization with struts. The same rules and principles apply to these situations as applied before.

Here crews tied the vehicle off at the front tires and then placed the struts under the body of the top resting vehicle.



In this scenario, crews tie the rear of the top sitting vehicle to the front of the bottom vehicle and then created a cradle with chains to support the weight of the top vehicle.



The cradle in the picture on the preceding page was created by running a heavy duty chain underneath or through some portion of the body or the vehicle. The chain is then attached to the heads of the struts that were placed on both sides of the car. The bases were then pulled together, creating tension on the chain which supports the entire weight of the vehicle. This is a very good method of setting up the struts to lift the vehicle as the head of the strut is not placed into any part of the vehicle, such as the skin, that may fail. Again, crews must follow the manufacturer's operating instructions and guidelines when creating this type of support system.

The following scenarios present emergency personnel with special considerations:



In both scenarios, there is the danger that what ever is holding the vehicle in place can break away under the weight of the vehicle. Tying off to these objects may not provide the necessary support if this occurs. In these particular situations, the act of tying off the vehicle in and of itself is extremely hazardous. On the left, crews would need to tie off to the cab of the truck because the rear end of the truck can no longer support its weight. On the right, just getting the strap to the truck presents many dangers. Personnel on scene could use an on scene emergency truck as a base, if possible two trucks positioned on either side of the vehicle could also be used as separate bases to distribute the weight. Truck mounted winches would definitely accomplish the task in both situations. Crews must also be sure that the wheels on their apparatus are chocked to provide more of a solid base and to minimize the possibility of apparatus movement.

Vehicle under rides

An under ride accident is caused when a one vehicle collides with another and becomes stuck underneath that vehicle. A good example of an under ride is when a passenger vehicle rear ends a Semi pulling a trailer. Usually the passenger vehicle pushes its way under the trailer, which ends up resting on and being supported by the passenger vehicle.



These accidents can present us with many difficulties. The first difficulty is the load that is being carried in the trailer. The weight in these trailers can be significant; often times the best way to proceed may be to unload the trailer prior to extricating the patient. Emergency personnel may elect to cut a whole through the side wall of the trailer to gain access to the material inside.

Another difficulty is the stabilization effort that will be required. In this type of scenario, there may be multiple units requiring stabilization, such as the passenger vehicle, the trailer or trailers being hauled and the semi itself. Stabilization of the trailer or trailers may be difficult because of the height of the trailers. On scene crews may not have a sufficient amount of cribbing if struts are not present. Also, the cribbing that is on scene may not be the correct size for the stacked height (remember the rule of thumb - ***cribbing should not be stacked to a height more than twice the length of the individual piece of cribbing***). If crews are using 24 inch cribbing, the stack should be no more than 48 inches or 4 feet tall. The higher the cribbing is stacked, the wider the base will need to be.

Even with these challenges present, stabilization of the trailers must be completed prior to the commencement of extrication operations. It is important for crews to understand that the structural support members of the passenger vehicle, such as the roof supports, posts, doors and even window frames and glass, may be acting in together to support the entire weight of the trailer. These parts of the vehicle may be the only things that are keeping the trailer from completely crushing the passenger compartment. Removing any one of these prior to stabilizing the trailers may cause the entire support structure of the car to fail.

Another common type of under ride accident occurs when a passenger vehicle is rear ended and pushed into and under a vehicle that is in front of it.



This scenario now presents us with another dimension of stabilization; not only do we need to stabilize the passenger car, but we also need to deal with the trailer and its contents and the fire truck that initially rear ended the passenger car.

As rescuers, our first inclination is to get our hands and body inside the patient compartment to begin rendering care to the trapped patient or patients. But the last thing we should do is attempt to break windows and force open doors. We must remain disciplined and resist the urge to do anything to the passenger vehicle until the trailer has been properly stabilized. Proper stabilization means that we use the right equipment with the proper capabilities to do the job. We need to know the capabilities of the tools we will be using and ensure that we do not exceed them. Pushing our tools beyond their rating capacity can be just as bad as not using any tools at all.

The picture below is a good example of exceeding the tools maximum rated capacity. This concrete mixer was filled to its maximum capacity when it tipped over onto the empty passenger car. It is extremely doubtful that two steel struts could support the weight of this concrete mixer. The passenger car's posts and doors are still helping to support some of the weight of the mixer but if crews began to force the door open or to cut the posts, a good portion of the supporting structure would now be eliminated. The struts might then have been overloaded and failed, resulting in disastrous consequences for crews operating in the hot zone and any patients trapped inside.



Again, there are no specific step by step instructions when it comes to stabilizing a situation such as this, each scenario will pose different challenges requiring different solutions and cribbing techniques. Once all vehicles have been stabilized, we can move on to extricating the patient.

These out of position vehicles will pose many challenges to fire fighters. Not every situation presented to us will be handled with primary stabilization alone. In those special situations, we may be required to think out of the box and come up with new tactics and procedures on scene.



As time goes on and knowledge is gained through training and real world experience, crews will become more proficient and confident in their stabilization skills. As long as we remember our stabilization basics, primary stabilization comes first, work with triangles to widen the vehicles base,

pay attention to the height of the stacked cribbing and think outside the box if necessary, even the most unusual incident will be handled with the skill and professionalism that is gained through years of hard work.